

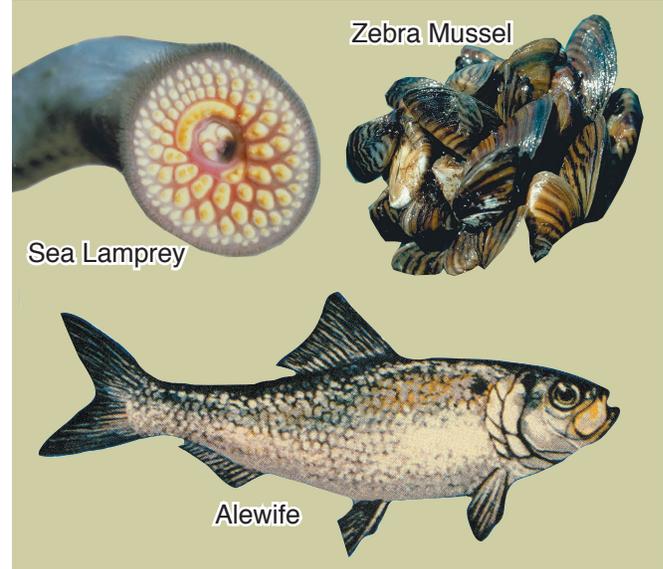
Exotic, Invasive, Alien, Nonindigenous, or Nuisance Species: No Matter What You Call Them, They're a Growing Problem

Human activities are profoundly affecting the earth's surface. Human population growth has been accompanied by a variety of stresses on natural ecosystems, including the unintentional introduction of various nonindigenous invasive species.

What are Exotic, Invasive, Alien, Nonindigenous, or Nuisance Species?

In general, these terms refer to plants, animals, or microscopic organisms growing where they don't belong. In the case of plants, the most common equivalent word is 'weed'. So why are there so many different terms? Each one has a subtly different meaning.

- ◆ **"Nonindigenous"** or **"alien"** describe a plant, animal, or microorganism living outside the area where it evolved. **"Exotic species"** has the same basic meaning, but is used more to refer to a plant, animal or microorganism not typically found in an area historically. Salmon, for example, are nonindigenous to the Great Lakes, but most people would no longer identify them as 'exotic', because they've been in the lakes for decades.
- ◆ In contrast to origin-based terminology, the term **"invasive"** describes a way of living and reproducing. An invasive species is one that can or does successfully reproduce (become "established") to form a sustained population in a new territory. Invasive species typically have high reproductive rates, good means of dispersal (for example, think of the wind-borne seeds of the common dandelion), and the ability to survive adverse conditions. Some native species can be invasive but because they evolved with the system in which they are found, native species usually have natural predators or other factors that help to keep their populations in check.
- ◆ **"Nuisance"** species are those that cause problems from a human perspective. For example, poison ivy is native to North America, but is considered an invasive nuisance plant. On the other hand, salmon in the Great Lakes are not considered a nuisance even though they are nonindigenous.
- ◆ A general rule of thumb used by many scientists is that about 10-15% of all introduced nonindigenous species actually become established, and about 10-15% of those that become established also become invasive and harmful.



Why Should We Care About Them?

A Costly National Problem

- ◆ The Office of Technology Assessment (U.S. Congress, 1993) calculated almost \$100 billion in U.S. economic losses over an 85-year period from just 79 nonindigenous species.

Ecosystem Impacts

Whether or not a particular invasive species is a direct nuisance to humans, it directly or indirectly may have profound impacts on the native plants and animals that share that home and the people who rely on those resources. The effects on the ecology of the ecosystem can even change through time.

- ◆ The alewife, a nonindigenous fish in the Great Lakes, was considered a costly nuisance in the early 1960's. Now it's considered extremely valuable as the primary food source for the trout and salmon that support a multi-billion dollar sport fishery. It was a management decision (the introduction of these sports fish into the Great Lakes) that eventually changed the value of this nonindigenous species.
- ◆ Zebra mussels have eliminated or nearly eliminated native clam populations in Lake St. Clair and western Lake Erie.
- ◆ Invasive water fleas, like the fishhook and spiny waterfleas change the food web important to young fish.

Benefits and Costs – Sometimes a Trade-off

In some cases, an invader may actually benefit one segment of the economy or a particular user group at the expense of others:

- ◆ Prior to the invasion of the zebra mussel (1986) it was difficult to see more than a few feet in the waters of Saginaw Bay, Lake St. Clair, and western Lake Erie. Since the zebra mussel invasion, one can see the bottom; a benefit for recreational boaters and divers.
- ◆ The way the zebra mussel feeds has been implicated in a recurrence of nuisance algal blooms (*Microcystis*) in these same areas during summer months, which cause taste and odor problems and increased treatment costs for municipal water supplies, and detract from recreational use.

Many of these changes are irreversible and require that human use of invaded ecosystems be adapted to the presence of the new species, sometimes at considerable economic cost.

So why are these species suddenly invading now?

The problem of exotic species is not really a new one. Plants, animals and microscopic organisms all tend to move around on their own, and may invade new territories naturally. They may even find their way across or around significant natural barriers (such as oceans), but at very slow natural rates. Humans have been helping to speed up this movement as long as we have been moving ourselves around the planet. A Canadian study calculated that humans have increased the dispersal of some aquatic organisms up to 50,000 times their natural rate.

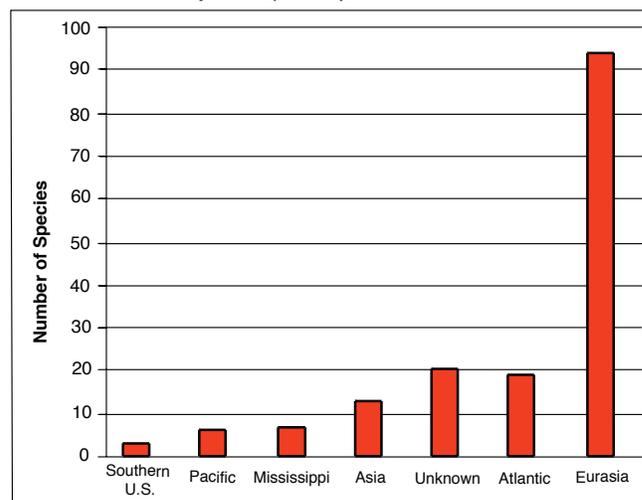
- ◆ Construction of shipping canals in the late 1800's and early 1900's directly breached the natural barriers to species movement between adjacent watersheds. For example, Niagara Falls blocked species passage between the Atlantic Ocean and the upper Great Lakes until the construction of the Welland Canal in 1829. Three species of Asian carp that escaped aquaculture sites in the southern U.S. are moving up the Mississippi River and may gain access to the Great Lakes via the Chicago Sanitary and Shipping Canal.
- ◆ The ballast tanks of cargo ships have been identified as the largest single contributor to the global movement of aquatic species in recent decades. Cargo ships are designed with large spaces to hold "ballast water," which is used to help stabilize the ship and adjust the way it rides in the water. A large cargo ship can hold tens of thousands of gallons of ballast water, which must be discharged when the ship takes on cargo.
- ◆ Over the last 50 years, technological advances have greatly increased the rate of transportation, and the trip for hitchhiking invaders has been made easier, faster, and more often. A trip between Europe and the New World which once took months

can now be accomplished by cargo ships in less than 7 days. A microscopic waterflea that might not have survived a month-long voyage in a ballast tank can more easily survive the trip today.

- ◆ Water quality in coastal zones and harbors has improved, making it easier for new species to survive.
- ◆ Another large source of potentially invasive nonindigenous species has been the garden, aquaria, and bait trades. A fisherman stopping for bait at his local store can now buy live worms imported from Asia -- unthinkable a century ago. The Northern snakehead fish, a freshwater fish native to Asia and recently found in Maryland and Florida is imported live into the United States and sold in fish markets as an Asian food delicacy.
- ◆ Globalization of world markets and the end of the Cold War increased the volume of overseas trade and the opportunities for transporting species. The increasing rates of new aquatic species invasions reported for many coastal aquatic ecosystems appear to parallel the expansion of human global economic trade.
- ◆ The increasing rates of new aquatic species invasions may also reflect wider recognition and attention to the problem -- we are simply looking harder.

Multiple routes and multiple means of transport have greatly increased the opportunities for species to enter new habitats, with unpredictable and possibly costly results.

Geographic Sources of Nonindigenous Species (N=162) in the Great Lakes



After Mills et al. (1993) and Ricciardi (2001).

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